Cross-Breeding Dairy Cows

by M. H. FOHRMAN

WE WONDERED whether the spectacular vigor of hybrid corn could be matched in dairy cattle—whether we could cross purebred, efficient Jerseys and Holsteins, for instance, and get an increase in milk that we could say was due to hybrid vigor. We started such an experiment in 1939, and our first results lead us to believe that a part of the gain we got might have come from the extra vitality.

We had some examples to follow. Breeders of poultry, swine, and beef cattle, and of corn and several other plants had had practical, even startling, results with crosses of different breeds. But little conclusive work had been done with dairy cattle. Nearly 30 years ago experiments in crossing Holstein-Friesian, Jersey, Guernsey, Ayrshire, and Aberdeen-Angus cattle were reported from Maine. Most of these experiments were made with mixed dairy and beef breeds and not dairy cattle alone. A study in the crossing of Guernseys and Holsteins was started in Massachusetts in 1911. At the University of Wisconsin some crosses were made with Jerseys, Holstein-Friesians, and Aberdeen-Angus. In most of the experiments, however, the level of the primary function of dairy cattle—milk production—and the transmission level of the bulls of the dairy breeds were not clearly established.

When the Bureau of Dairy Industry began to explore the field of cross-breeding of dairy cattle at Beltsville, we brought in foundation females from the proved-sire bred herds at our field stations—Holsteins from Huntley, Mont., and Mandan, N. Dak., Jerseys from Lewisburg, Tenn., and Guernseys from the Sandhill station in South Carolina. Females of the Red Danish milk breed were available at Beltsville, as well as proved Holstein, Jersey, and Red Danish sires. All foundation females were from production-bred herds—the bulls had proved they

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could beget heifers that surpassed their mothers. We felt that the blending of these proved stocks would bring forth any hybrid vigor that might be expected to result from interbreed matings.

The project differed from the usual pattern of crossing breeds in that it called for continuous introduction of new genes, the units of inheritance, through the use of proved sires of different breeds. We proposed to have only a limited number of interhybrid matings. Females resulting from mating Holsteins and Jerseys, for example, are mated to Red Danish sires for the three-breed crosses; such females, in turn, are mated to either Holstein or Jersey proved sires in a second round of the three breeds involved.

The Holstein sire, No. 966, was bred at Beltsville, and proved in a cooperating herd before he was used in cross-breeding. Thirty-one of his daughters, milked three times daily for 305 days, had an average mature equivalent of 18,416 pounds of milk and 645 pounds of butterfat, compared to an average of 17,772 pounds of milk and 619 pounds of butterfat for their dams. This sire also proved to be heterozygous for color and had sired several red and white calves.

The Jersey sires were herd bulls bred at Beltsville and proved in cooperating herds. Most of the Jersey matings were made to No. 1114. The Red Danish bull had been proved in the herd at Beltsville, and all Red Danish matings until April 1944 were made to him.

All the females were weighed and measured periodically. Their ability to produce was determined in the first lactation period under uniform conditions. All were milked three times daily for a 365-day lactation period and were bred about 4½ months after calving. During the milking period, all were barn-fed, because pastures at Beltsville vary and their beneficial effects would not appear with all cows at the same stage of lactation. The cows were fastened in stall ties and were turned out in a dry lot for a short time after milking, when weather permitted.

We crossed four breeds, and tried to keep all combinations in numerical balance. No reciprocal or reverse crosses with Guernseys were made because we had no proved Guernsey sire. Only a few matings of Jerseys and Guernseys were made because we thought they are too much alike. With the Holstein, Jersey, and Red Danish breeds, the plan was to make reciprocal crosses, but the matings of Holstein and Jersey bulls to Red Danish females were held up for a while in order that we could increase the size of the Danish herd. (A reciprocal cross is one that is the opposite of a previous mating; for example, the mating of a Red Danish bull and a Holstein cow would be the reciprocal of one between a Holstein bull and a Red Danish cow.) Some of the groups were upset by unbalanced sex ratios, but we are trying to bring the group to equal numbers.

The accompanying table shows the records of the crossbred cows that

completed one lactation period or progressed far enough to afford an estimate of their ability. All cows that came into milk are listed—no culling was practiced. To help in making comparisons, let me point out that the average production of all cows in the Dairy Herd Improvement Association herds in 1945 was 8,592 pounds of milk and 346 pounds of butterfat and in 1941, 8,225 pounds of milk and 335 pounds of fat on two milkings daily; and 226 junior 2-year-old Holsteins included in the Advanced Register test for 1945 averaged 13,833 pounds of milk and 493 pounds of fat on three milkings daily. The average of this class has been close to 500 pounds of fat since 1933.

Production records of the cows used in cross-breeding experiments at Beltsville

No. of cow	Pounds of milk	Percentage of fat	Pounds of butterfat	Age (years and months)	Remarks
JERSEY BULL × GUERNSEY COW					
X–13	10, 653	5. 27	562	2–2	
JERSEY BULL × HOLSTEIN COW					
X–1	9, 784	4. 85	475	2–0	
X–3	13, 065	4. 71	615	1–11	
X–17	13, 837	3. 85	533	2–3	
X–32	13, 728	3. 94	540	1–11	
X–35	10, 508	5. 24	550	2–1	Mastitis.
X–41	12, 453	4. 63	576	2–5	
X–42	9, 417	4. 90	461	3–3	
X–47	12, 189	5. 13	625	1–8	
HOLSTEIN BULL × JERSEY COW					
X–5	13, 032	4. 62	602	2–4	
X–11	12, 584	4. 82	606	2–4	
X–20	12, 383	5. 13	636	1–11	
X–30	11, 867	5. 60	664	2–0	
X–38	11, 929	5. 09	607	2–1	
X–40	13, 690	4. 74	649	2–8	
X–51	13, 800	4. 44	613	2–5	
HOLSTEIN BULL × GUERNSEY COW					
X–16	14, 577	4. 68	683	2–5	
X–26	11, 717	4. 84	567	2–0	
X–28	14, 052	4. 63	651	2–3	
X–33	11, 363	5. 53	629	2–0	
X–43	11, 990	4. 12	494	2–4	Mastitis.
X–44	15, 284	4. 10	627	1–11	
X–45	11, 341	4. 95	561	2–9	
X–59	8, 471	4. 70	398	2–9	231 days, incomplete.

Production records of the cows used in cross-breeding experiments at Beltsville—Continued

No. of cow	Pounds of milk	Percentage of fat	Pounds of butterfat	Age (years and months)	Remarks
RED DANE BULL × HOLSTEIN COW					
X–14	13, 643	4. 05	552	2–2	
X–22	16, 949	3. 60	611	2–2	
X–23	14, 636	3. 77	552	2–0	
X–46	11, 103	4. 05	449	1–11	Mastitis.
X–56	16, 100	4. 08	657	2–0	
X–58	13, 956	4. 27	596	2–4	
X–63	14, 030	3. 79	532	2–4	279 days, incomplete.
HOLSTEIN BULL × RED DANE COW					
X–15	12, 730	4. 04	514	2–3	
RED DANE BULL × JERSEY COW					
X–7	12, 228	4. 80	586	2–7	
X–10	12, 561	5. 03	631	1–11	
X–18	13, 315	5. 06	674	2–2	
X–29	12, 691	4. 56	579	1–11	
X–70	9, 295	4. 25	395	1–11	268 days, incomplete.
RED DANE BULL × GUERNSEY COW					
X–21	14, 614	4. 12	602	2–1	
X–52	14, 044	4. 30	603	2–2	
X–53	14, 055	4. 79	674	1–11	
X–61	12, 463	4. 35	542	1–11	
X–73	7, 066	3. 98	281	2–0	196 days, incomplete.

Some footnotes to the records are needed. One Jersey × Guernsey heifer died in her first lactation period. The Jersey-Holstein crosses X–17 and X–32 were sired by Jersey bulls other than No. 1114, and are considerably below the other six in percentage of butterfat. The early calving of X–47 came about because she was bred by a young bull in the calf barn. Five more Holstein × Red Dane heifers, sired by No. 966, were under production age when this tabulation was made. All the Red Dane × Jersey heifers were sired by D–501. Four heifers from Red Dane cows, sired by Jersey bull No. 1114, were born, but two died and two were under calving age when we compiled our records. Two more Red Dane × Guernsey heifers are in the herd; six of the seven are by sire D–501. Analyses of birth weights and growth and comparisons of daughters with their dams await results of further work and tests.

In all, 38 females of the various two-breed combinations completed production records. Their average production was 12,904 pounds of milk and 588 pounds of butterfat; the average test was 4.60 percent of butterfat, and average age at calving, 2 years and 2 months. Four incomplete records not included in the average should not materially alter it. Ten heifers had not come into milk; they will bring our total of two-cross animals to 52; in breeding large animals, that is a sizeable group, and when handled under carefully controlled conditions the results are indicative. A few records have been interfered with by mastitis, but on the whole there has been a free expression of inheritance in these cattle.

The average production of the different combinations varied somewhat, but the numbers in each group were relatively small, and a few additional animals in each group might bring the production more in line. There is a possibility of some genetic difference in the sires, however, but at this stage it appears that the heifers sired by the Holstein No. 966 and Red Dane D–501 are about equal and somewhat better than those sired by Jersey No. 1114 and the two other Jersey bulls used.

Most of the 38 crossbred heifers produced better than their dams. Since they are daughters of proved sires, it was to be expected that they would outproduce their dams. We carefully analyzed the production records of their ancestors and calculated the amount of the average increase that we could expect. We found that the actual increase in production of the daughters over dams was more than the increase we had expected. This may be due to hybrid vigor.

The answer to the question of breed intermating is slowly evolving, as more of the three-breed combinations come into production, and the limited information now available is here tabulated.

Fourteen more three-breed hybrids were sired by No. 966. Seven are from Red Dane × Jersey dams, three from Red Dane × Guernsey dams, one from a Jersey × Guernsey dam, and the other three are from dams which resulted from crosses of three breeds. This is the beginning of the second cycle of three breeds.

Thirteen other three-breed heifers were sired by Red Danish bulls, one by D–501, four by D–540, an inbred son of D–501, seven by D–508, and one by D–507. Five are from Holstein × Guernsey dams, six from Holstein × Jersey dams, and two from Jersey × Holstein dams.

Three other three-breed heifers were sired by Jersey No. 1114, two from Red Dane × Holstein dams, and the other from a dam representing three breeds.

Only eight of these three-breed animals have completed 365-day lactation records; their average is not conclusive, but it is impressive. The eight averaged 14,927 pounds of milk and 641 pounds of butterfat—average test 4.32 percent—at an average age of 2 years. The incomplete records available at this time do not indicate that this average

Three-breed crosses sired by Holstein Bull No. 966

No. of cow	Parentage of dam	Pounds of milk	Percentage of fat	Pounds of butterfat	Age (years and months)
X–50.....	Red Dane × Jersey.....	16, 186	3. 97	643	1–11
X–62.....	.....do.....	16, 862	3. 92	661	2–0

Three-breed crosses sired by Red Dane bulls

No. of cow	Parentage of dam	Pounds of milk	Percentage of fat	Pounds of butterfat	Age, years and months	Remarks
X–39...	Jersey × Holstein.....	13, 992	4. 35	609	1–11	
X–54...	.....do.....	16, 500	4. 16	686	1–11	
X–55...	Holstein × Guernsey.....	15, 284	4. 47	684	2–1	
X–60...	.....do.....	15, 036	3. 98	598	1–11	
X–65...	Holstein × Jersey.....	12, 896	4. 67	602	1–11	
X–66...	Holstein × Guernsey.....	11, 037	4. 30	475	2–3	240 days, incomplete.
X–68...	Holstein × Jersey.....	6, 605	4. 78	316	2–3	177 days, incomplete.
X–71...	.....do.....	7, 788	4. 42	345	2–0	208 days, incomplete.
X–75...	.....do.....	6, 170	4. 94	305	1–11	182 days, incomplete.

Three-breed crosses sired by Jersey Sire No. 1114

No. of cow	Parentage of dam	Pounds of milk	Percentage of fat	Pounds of butterfat	Age, years and months	Remarks
X–48...	Red Dane × Holstein.....	12,668	5.07	643	2–0	
X–77...	Holstein × Red Dane.....	5,858	4.11	240	2–0	164 days, incomplete.
X–81...	Red Dane × Holstein.....	5,175	4.67	242	1–11	152 days, incomplete.

will be greatly reduced, and it is significant that all but one of these three-breed heifers exceeded their two-breed dams in production of butterfat.

One of the striking characteristics shown by all of these crossbred animals is their persistency in milk production. Often the monthly butterfat production varies less than 10 pounds from the high month to the low month. This is perhaps one of the factors that adds to the

production potential of the proved sires used in this study and in our other proved-sire breeding.

Some intermating of hybrids has already been worked into the project. That is being done in a limited way in order to check the transmitting ability of males bred like the females listed above. Cross-bred bull X–120 was a son of Red Dane D–501 and his dam was a Holstein foundation cow. He was kept a while for use on heifers that might be difficult to settle and two of his daughters are in the herd. The first of these is X–49; her dam was a Holstein × Jersey female, and she is therefore a three-breed cow with Holstein in both sire and dam. She freshened at 2 years of age and produced 14,082 pounds of milk and 658 pounds of butterfat, testing an average of 4.68 percent. Her dam freshened at 2 years and 4 months and gave 12,584 pounds of milk and 606 pounds of butterfat with an average test of 4.82 percent. One case proves nothing but is an indication that the inheritance for milk and butterfat production should be the same in these males as has been demonstrated by the females of similar breeding.

Two other bulls have been sampled. X–179 is a son of D–501 and his dam is a Jersey × Holstein. He has three daughters in the herd—all from three-breed dams. X–191 is also sired by D–501, and his dam is a Holstein × Guernsey. There are six of his daughters in the herd, four from three-breed dams and two from two-breed dams.

A summary of the records completed by 38 two-breed and 9 three-breed cows shows an average of 13,273 pounds of milk and 599 pounds of butterfat—average test 4.55 percent; average age 2 years 2 months.

We are conducting this cross-breeding project in order to develop exact knowledge on the subject. Results obtained so far may warrant a few speculations as to the applications.

First, we must emphasize that production-bred foundation stock and production-proved sires were used almost entirely. It can be said, therefore, that similar results can be expected only where proved stock is used in making the crosses. This emphasizes the value of proved sires in breeding for milk and butterfat production. Factors that control those yields appear to be similar in the different dairy breeds. Numbers are large enough and we have enough combinations to indicate that we can repeat our good results if good sires are used.

The standard warning against cross-breeding is that "if Holsteins and Jerseys are intermated the resulting animals will produce Jersey quantity and Holstein quality of milk." This may be true with random-bred animals of the two breeds, but actually we can normally expect that the chances for Holstein quantity and Jersey quality of milk are as likely as the reverse, and that most of the offspring will produce at an interbreed level in both milk and percentage of butterfat.

This type of cross-breeding holds possibilities for expanding the useful-

ness of our registered cattle because proved sires of the different breeds must be used in all crosses—at the start and in later matings—to maintain the high level of production and add hybrid vigor.

Commercial application awaits the demonstration of the hybrid's superior ability. Many commercial milk herds lack facilities for raising their own replacements, and are always in the market for dairy cows and heifers. Cross-breeding fits well into the latest advances that are being made in dairy cattle-breeding practices. Artificial insemination, for example, permits of the expansion of cross-breeding work without the necessity of keeping extra herd sires. Let us assume that a dairyman in a region with good pastures and an abundance of cheap home-grown roughage has followed a practice of selling about 10 or 12 extra heifers each year from a herd of 50 milking animals. This represents the surplus females above his requirements for herd replacements. If he is a member of an artificial-breeding association he can order semen from proved bulls of other breeds than the one he owns to impregnate 20 or 25 cows in his herd, and these crossbred calves will be sold as surplus. When the market appreciates the value of well-bred hybrid heifers, they should bring a premium price and will cost no more to raise than straight-bred heifers.

Hybridizing may also appeal to the man who has spent 10 or 15 years building up a good producing grade herd, only to find that the closed herd book is a bar to his ever having any of his good cows registered. To become a breeder of registered stock he must sacrifice his good grade cows and purchase registered females, even though his herd may have been bred entirely from registered bulls. His surplus cows are sold for dairy purposes and the basis of their value should be their production records. If cross-breeding can raise the level of production of cows in his herd, their value when sold should be increased correspondingly.

THE AUTHOR

M. H. Fohrman, head of the Division of Dairy Breeding, Feeding, and Management of the Bureau of Dairy Industry, has been in charge of the Department's dairy-cattle breeding work at Beltsville since 1921.

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FOR FURTHER READING

Fohrman, M. H., and Graves, R. R.: *Experiments in Breeding Holstein-Friesian Cattle for Milk- and Butterfat-Producing Ability, and an Analysis of the Foundation Cows and of the First Out-Bred Generation,* U. S. D. A. Technical Bulletin 677, 1939.